

**Research Article**

# Creating Science Online Learning Media Using Scratch App Block Programming

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**Abstract.** A difficulty faced by science teachers in online teaching is the inability to apply science materials straight to the students. This research examined how Scratch app block programming can be used on a personal computer or tablet to create science instructional tools to be used online. It was found that the steps to do so are: (1) downloading the Scratch app and running the file; (2) creating designs for the project with e.g. backdrops, paint, costumes; (3) coding or programming the scripts while choosing blocks in block palettes for the science project; (4) dragging and dropping the blocks to the script area for setting the parameter, operator, control, motion, look, sound, sensing and motion block inputs for the program; and (5) saving and running the block code/script in the scripts area. The researchers found that the Scratch app was effective in creating an online medium for learning about science and applying science concepts in everyday life.

**Keywords:** science learning, measurement, online learning, scratch app, block programming, computational thinking

## 1. INTRODUCTION

Science education for prospective teachers at the higher education level faces new challenges during the COVID-19 pandemic. Educators are required to be more creative and imaginative in carrying out teaching with the help of media so that the science concepts taught are more easily understood by students. The use of media and teaching aids in teaching science greatly supports the success of teaching [1]. Lecturers teach the concept of measurement in science which is usually done traditionally and boring for students, by giving material through lectures, introduction to formulas and practice questions, with the help of powerpoint media and projectors during face-to-face lectures. With the time to study face-to-face lectures and limited media for science learning in the pre-pandemic period, few students were able to obtain, understand the

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material, apply, and develop measurement material so that it was less interesting and fun to study. Teaching which is still centered on lecturers with limited media for 21st century students certainly makes them easily bored, less active, creative, and imaginative. While the essence of science and learning science must be done in a scientific method and creatively [2][3][4]. With the obstruction of face-to-face teaching on campus during this pandemic for over a year and switching to online learning using a computer/laptop or mobile phone, it is necessary to adjust teaching to be more interesting and in accordance with technological developments in the era of the industrial revolution 4.0. Where science teaching and learning media are expected to make more use of and use the materials available online and students can use applications and practices of science concepts that can be done online as well to make learning more fun [5][6][7]. With the demands of online learning, students can learn more from home, anywhere and anytime with their own time, compared to face-to-face lectures in class. Online learning requires students to be active independently to be able to understand the learning material with proper direction from the lecturer [5].

One alternative to making science learning media for online or digital measurement materials for prospective elementary school teachers with the help of technology is to use the Scratch application, which is a programming utilization which makes animations, contests, simulations, and bilateral medium [8]. Learning using multimedia is very suitable for today's digital age and is very interesting for students in learning [9]. The capability to program the computer is a significance portion of reading/writing ability in nowadays community. When student study to program in Scratch, they gain significant method for overcome the issues, scheming projects, and delivering thoughts [10]. Besides being able to be used for science learning materials, this application can also be used for Mathematics, Language, Music Arts, and Social Sciences subject matter [11][21].

Many previous research results used the Scratch application for science learning and were used as a medium for students to understand science concepts more easily and interestingly [12]. Scratch utilizations have so been studied by multidisciplinary scientists to advance scientific and mathematical notions that employ Scratch as a shift from a block-based programming situation to a text-based setting using Python or C [13]. Scientists have also attempted to involve in the educators' professional development by employing computational thinking skills and coding as learning devices in fields of study like science, language, mathematics, also music [14][21].

Numerous academic works have demonstrated lest the Scratch application has the potency to help educators and prospective teachers in building interesting studying

medium and implementing teaching to their students by using computational thinking skills in programming that is applied to this application [15]. If we look at the development of the use of the Scratch application on other continents, of course this case is diverse with that in Indonesia, notably in West Sumatra where science educators, notably for primary institutions, are very least in developing computers-supported science study tool because of the case of instructors or prospective teachers that are mostly so far high-tech savvy and do not understand computer programming. This article objective is to present an model for science lecturers in universities for prospective primary school teachers that programming with the Scratch application is barely easy to be usaged and practiced to make various teaching materials or as a media to support science learning, especially on measurement materials.

## 2. METHODOLOGY/ MATERIALS

This study uses a narrative design approach with the subsequent phases: (1) download along with putting the Scratch app or get the Scratch app on the Microsoft Store, and run the .exe file (2) creating designs for projects with backdrops, sprites or paint costumes, (3) code or programming the scripts with choosing block in block palette for a science project, (4) drag and drop the blocks to script area for setting the parameter of motion, look, sound, events, control, sensing, variables, operators blocks inputs to program it, and (5) save and run the blocks code/script in scripts area. The major app applied is the Scratch desktop app version 3.15.0 which can be obtained for free on <https://scratch.mit.edu/>. Scratch was created notably for ages 8 to 16, but is employed by people of all ages from primary institution to higher educational institution.

Learning media on measurement materials made through scratch programming are formulas for measuring area and volume, measuring temperature, measuring density of objects, measuring object speed, measuring force, measuring distance, measuring energy and power.

## 3. RESULTS AND DISCUSSIONS

With Scratch, many researchers have programmed their own interactive stories, games, simulations and animations and share their creations with others in the online community with a simple coding process [16][17]. Scratch helps young people learn to think creatively, reason systematically, and work collaboratively, essential skills for life in the 21st century. Scratch is designed, developed, and moderated by the Scratch

Foundation, a nonprofit organization. It is provided free of charge. These subsequent showed simple steps used to create science learning media for the students of primary school teacher education department. Researcher represent measurement formulas as studying medium and at together with either basic coding formulas that had to be presented to the scholars.

### 3.1. Download along with Install the Scratch App

At the initial phase is to prepare the Scratch app to be download along with installed to our personal computer to be able to work offline. The app could be download through the <https://scratch.mit.edu/download/> webpage. Scratch could be set up as versions of Windows 10+ and Mac OS 10.13+. Based on our experience, the computer or the latest Windows operating system version 10 and above strongly supports the current Scratch variant.

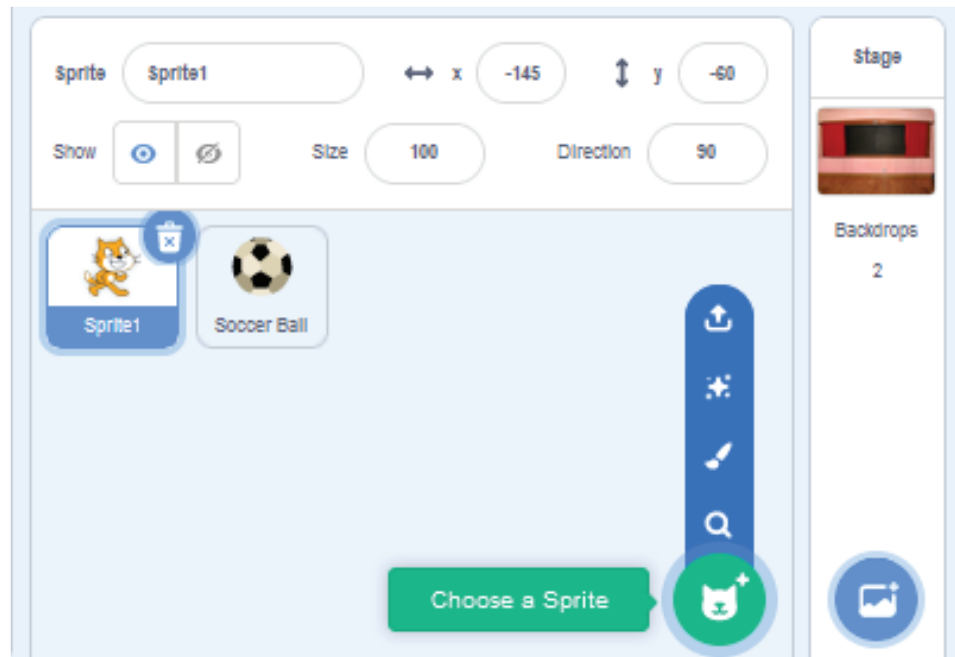
### 3.2. Creating Designs for Project with Backdrops, Sprites or Paint Costumes

The second phase after installing the application is to choose a sprite and backdrops design from sprite list for science project that will be applied as a learning media. The Sprite List shows names and thumbnails for all the sprites in our work. New tasks start with a white Stage and a single cat-costumed sprite. The sprite icon under the Sprite List let us add new sprites to our work (in this case a ball sprite image) from one of four places: Scratch's sprite library, the built-in Paint Editor (where we can draw our own costume), surprise from Scratch's sprite library, or upload sprite file from our computer. Each sprite in our project has its own scripts, costumes, and sounds.

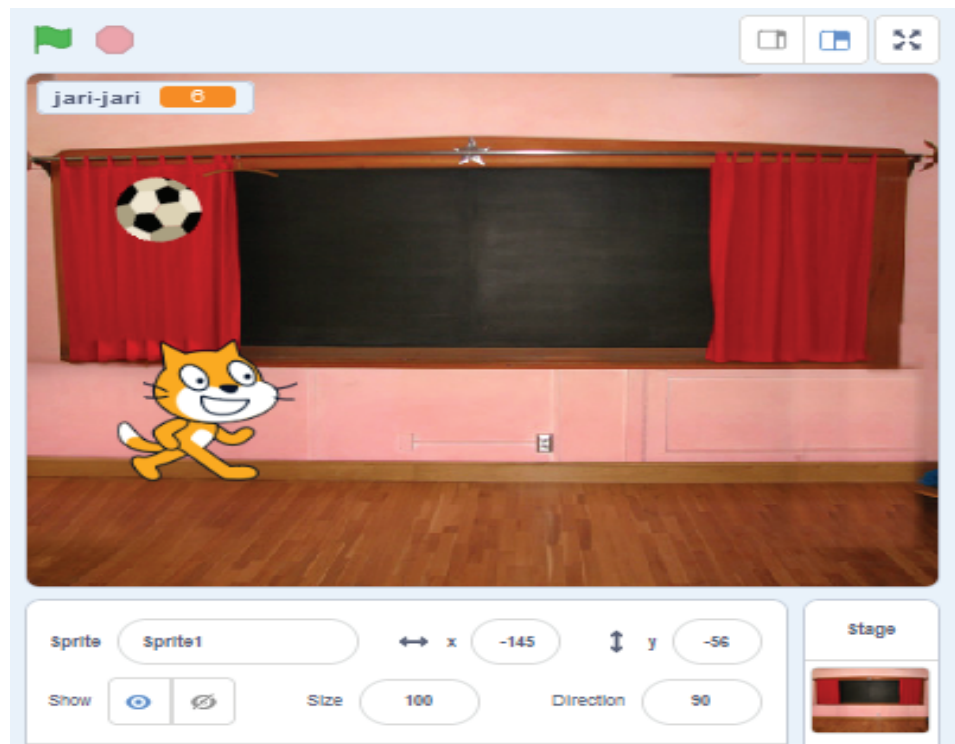
Together with thumbnails for our sprites, the Sprite List also displays a thumbnail of the Stage to the below (see Picture 1). The Stage has its owned set of scripts, images, and sounds. The background image we see on the Stage is named a backdrop. When we begin a new project, the Stage defaults to a plain, white backdrop, but we can add new backdrop images with any of the four options below the Stage's thumbnail.

The Stage is where our sprites move, draw, and interact. The Stage is 480 steps wide and 360 steps tall, as illustrated in Picture 2. The center of the Stage has an x-coordinate of 0 and a y-coordinate of 0.

Display Area, resided precisely under the Stage. The green flag and stop icons let us start and end our program. The hide/show choice admit us to turn if a sprite on the

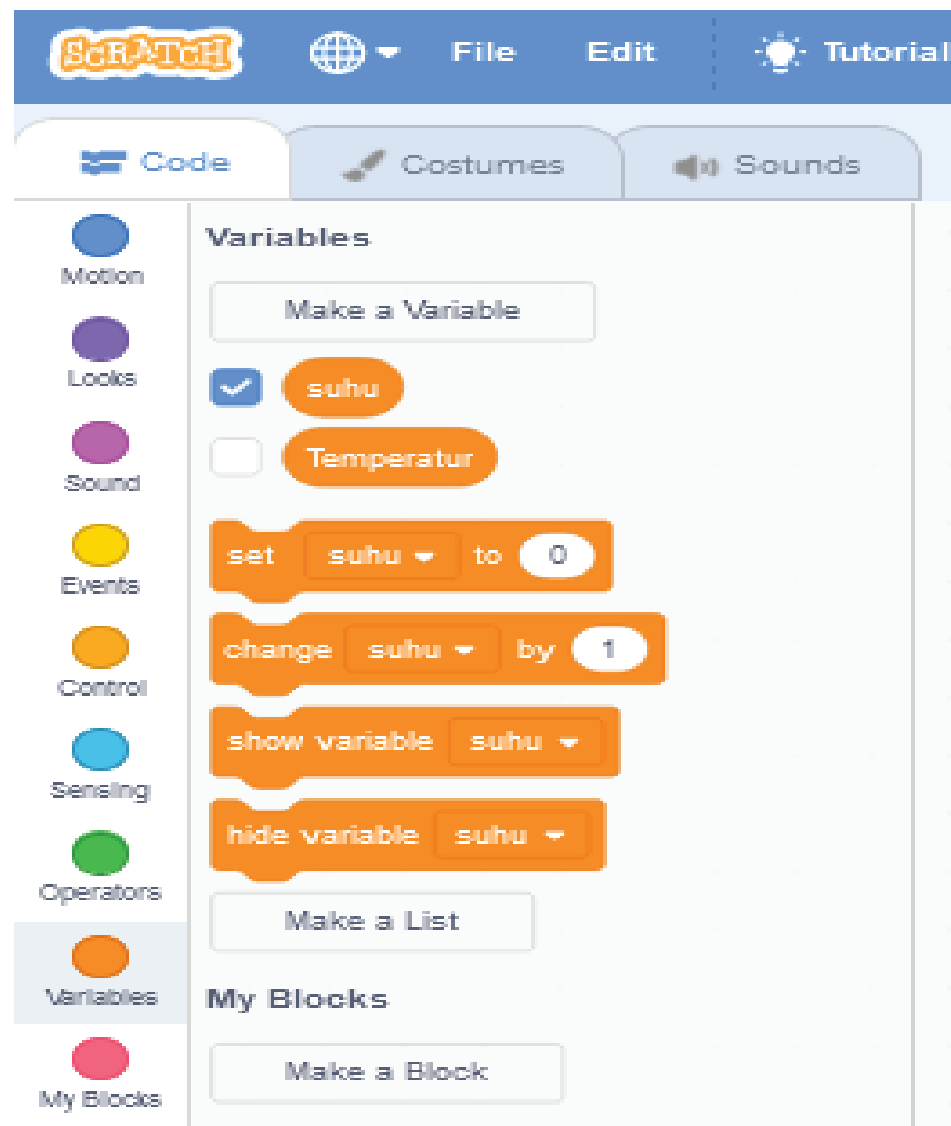


**Figure 1:** Choosing a Sprite Costume. (Source: <https://scratch.mit.edu/projects/editor>)



**Figure 2:** Choosing a Backdrop. (Source: <https://scratch.mit.edu/projects/editor/?tutorial=getStarted>)

Stage is visible or not. We also can change or adjust the size and direction of the sprite we choose to the stage area available on Scratch.

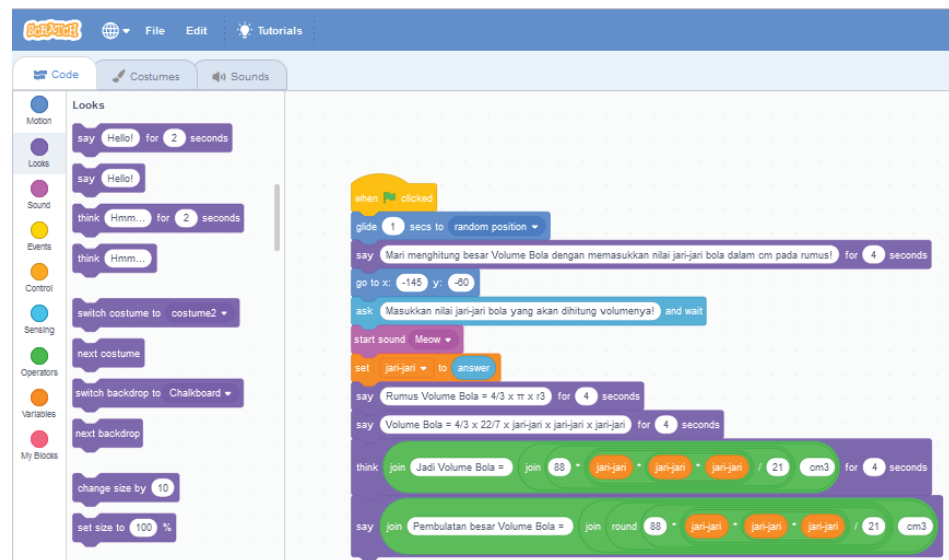


**Figure 3:** An Enlarged View of the Blocks Palette. (Source: <https://scratch.mit.edu/projects/editor>)

### 3.3. Coding or Programming the Scripts with Choosing Block in Block Palette

The third step is to choose block in block palette to make a code or script for each sprite science project according to the sequence of the sprite appearing on the stage. Blocks palette in Scratch is split within 9 groups (palettes): Motion, Looks, Sound, Events, Control, Sensing, Operators, Variables and My Blocks. To assist us finding associated blocks quickly, so the blocks are color coded. We can look at the numerous of the Blocks palette in Picture 3.

To see what blocks does, we click a block palette. **Say Hello! for 2 secs** block (in the Looks palette) if clicked can create the sprite show “Hello!” for two seconds in a speech



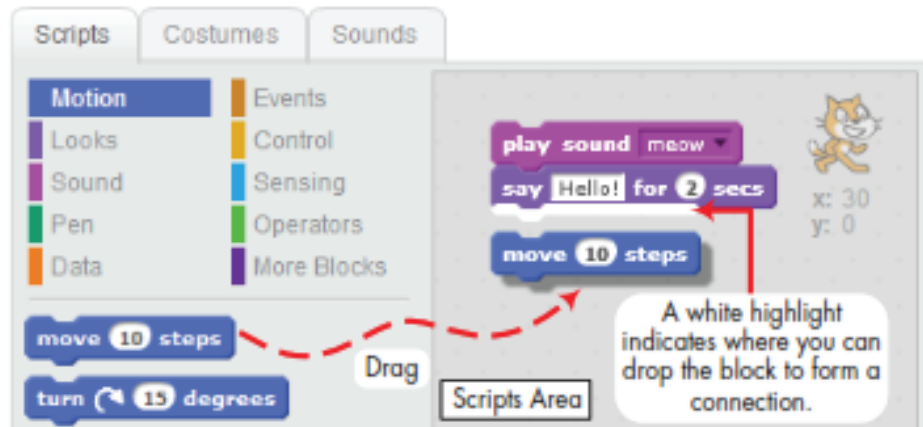
**Figure 4:** An Enlarged View of the Blocks in the Looks Palette and in Script Area. (Source: <https://scratch.mit.edu/projects/editor>)

bubble. In Picture 4 we can see the block display “Mari menghitung besar Volume Bola dengan memasukkan nilai jari-jari bola dalam cm pada rumus!” in a speech bubble for four seconds.

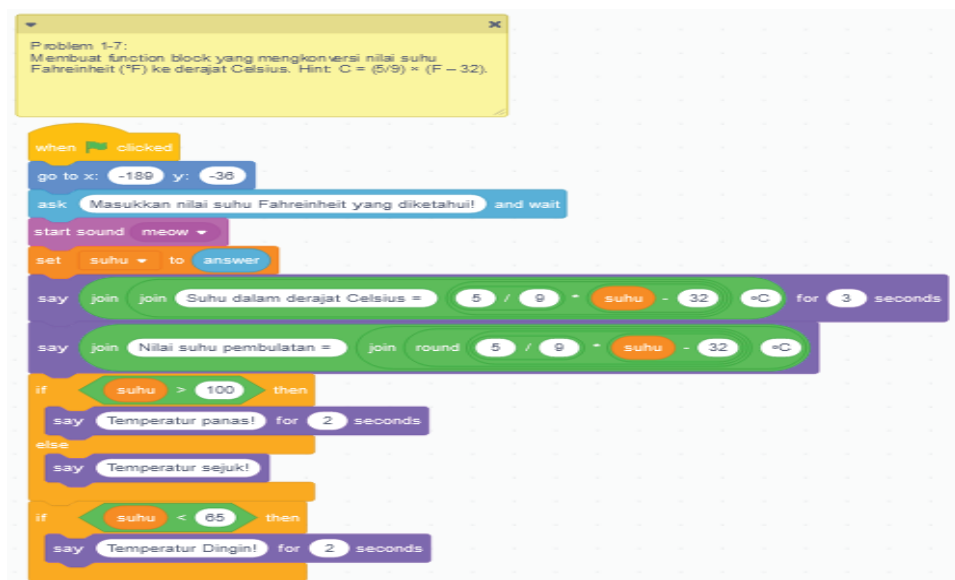
To create a programmed temperature measurement conversion, we have to choose some blocks from several block palettes. In this program we choose: a **When green flag clicked** from events palette, **ask What's your name? and wait** block from sensing palette, **start sound Meow** block from sound palette, **Make a Variable** suhu from variables palette, **set suhu to** from variables palette, **answer function** block from sensing palette, **say Hello! for 3 secs** from looks palette, **join apple banana** function block from operators palette, **division**, **multiplication**, and **subtraction** function blocks from operators palette, **round** function block from operators palette (see Picture 4). Next later we drag and drop the blocks to script area, stacked the blocks on top of each other in succession to make a script.

**Glide 1 secs to** blocks shown in Picture 4 also have an input space. **Set to** block have a pull-down menus for their inputs, so with **start sound Meow** block.

**Ask and wait** block as command block for scratch sensing that can use to read user input in the form of a question as shown in Picture 4. After the user fill in the blank box, the user must press the enter key or click the checkmark at the right side of the input box. After that, Scratch saves the user’s input in the **answer** block and go on carrying out at the request shortly after the **ask and wait** block.



**Figure 5:** Drag and Drop Blocks into the Scripts Area to Make the Scripts. (Source: Learn to program with Scratch)



**Figure 6:** Blocks Script to Convert Fahrenheit to Celcius. (Source: <https://scratch.mit.edu/projects/editor>)

### 3.4. Drag and Drop the Blocks to Script Area for Setting Parameter of the Blocks Inputs to Program It

To program a sprite as we want, we can do it by drag and drop the blocks we choosed to the sript area (Picture 5).

Some blocks need one or several inputs (labeled as arguments) that instruct the block what to perform. The number -189 and -36 in **the go to x: -189 y:-36** block is an example of an argument, also the numbers on formula to convert Fahrenheit to Celcius. Look at Picture 6, we can change the position of the sprite by changing number in **go to x: y:** white space by clicking it and change number -145 with -189 shown in Picture 6.



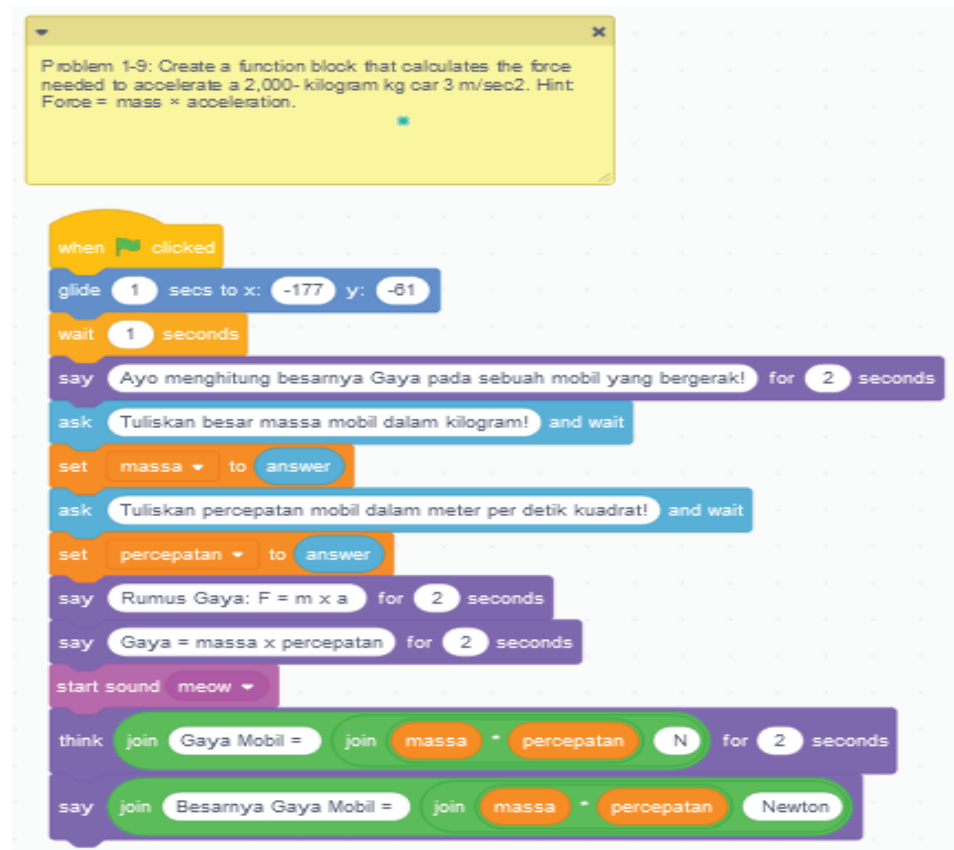


Figure 7: Blocks Script to Calculate Force. (Source: <https://scratch.mit.edu/projects/editor>)

### 3.5. Save and Run the Blocks Code/Script in Scripts Area

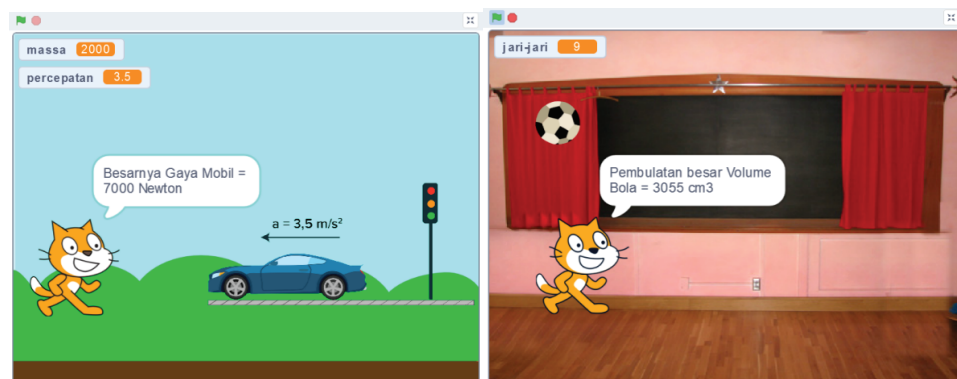
The last step is to play the script block for measurement demonstration through a computer keyboard. We drag and drop the **When green flag clicked** block from events palette so that it can start or run the script at the beginning of programming. Save the programming block by clicking the **File** menu bar and choose **save to your computer** option.

The measurement block display demonstration can be extended by pushing down the full screen control on stage, a small bar located above the stage. The full screen mode fill all our screen display. The measurement learning can be executed via this view.

Users can input the numbers or characters measurement asked by the program (Picture 8) and then press enter button on computer keyboard. The programming block processed and displayed the result (Picture 9). Teachers and students can exhibit carry out the measurement programming block in science learning, and other programming simulation blocks for science or students can make, create, and modify their own



**Figure 8:** Entering Answer Numbers on Ask Blocks Script Buble. (Source: <https://scratch.mit.edu/projects/editor>)



**Figure 9:** The Result Displayed of Force and Volume Measurement. (Source: <https://scratch.mit.edu/projects/editor>)

programming block. Therefore, both educators and scholars could upgrade their high-tech education adapt to latest studying circumstances that request a contact with computer tech [18][19][20]. Other research results indicated that significant improvements in students' learning outcome and in their attitudes towards learning mathematics and science with the assistance of technology [13][21].

## 4. CONCLUSION AND RECOMMENDATION

Stand on this investigation, it could be wrap up that the use of programming with the scratch app very useful for making elementary science learning media on measurement material. Programming with this application is quite simple by drag and drop so that it allows prospective elementary school science educators in particular, to make science learning media on measurement material more interesting and creative. Scratch application programming for measurement materials can be used as the basis for making media for other science materials such as the motion of objects, electricity, optics, sound and the universe as well as material for the practice of other science materials through technology support and kits provided to be introduced and taught to students elementary school teacher candidates in this 21 century era education.

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